8201

Series Enclosed Arc Lamp Street Lighting System

Installation, Care and Maintenance

General Electric Company

Schenectady, N. Y.

Dec 6, 1902 No. 8201

INTRODUCTION.

IN the early days of arc lighting the lamps, and therefore the system sometimes, suffered from neglect or carelessness of inexperienced trimmers. Similar troubles have occurred when in the progress of the industry newer and better forms of lamps and apparatus have fallen into the hands of tenders familiar only with old standards and impatient with the peculiarities of new construction and operation. The modern trimmer, however, realizes the importance of complete acquaintance with the lamps in his care, and the modern station superintendent, assured that full information is essential to intelligent work, gladly affords the trimmer every opportunity to increase his knowledge. A special study of the arc lamp and the methods of handling it on the part of those who actually do the work results in better operation of the system, which is bound to be appreciated by the officers of the company as well as by the public. In addition to the regular arc lamp instruction books and bulletins, the General Electric Company has prepared the following pages with the special object of furnishing arc lamp men with complete information on its enclosed arc lamps.

STREET LIGHTED BY 66 AMPERE LAMPS 400 FEET APART

SERIES ENCLOSED ARC LAMP STREET LIGHTING SYSTEMS.

INSTALLATION, CARE AND MAINTENANCE.

THE modern enclosed arc lamp system can be operated with little attendance and small maintenance expense as compared with the old open arc system. In order to secure gratifying, or even satisfactory results, however, the apparatus must have certain attentions. The majority of complaints made by users of our series arc lighting systems, are found on investigation to result from want of familiarity with the system on the part of the trimmers and station operators, and in general the inefficiency of the arc lamp organization.

The object of this book is to indicate the most modern and efficient methods of operating an arc lamp system.

INSTALLATION.

LINE CONSTRUCTION.

The marked advantages of the enclosed arc systems are gradually but surely leading to the displacement of the old open arcs. In making these changes, the service throughout the city has to be maintained, and in most cases, the same line construction is used for the new system.

It is seldom that a series direct current open arc circuit is so arranged as to be subjected to an insulation

strain above 3500 volts On the larger type of brush machines connections are made for multi-circuits, thus dividing the out-put voltage of the machine in the 2, 3 or 4 circuits Under no condition can the machine give out more than the potential of the individual circuit. Without entering into the subject of high tension line construction, it may be stated that the higher voltage strain on the line with the series alternating system should be considered

Series alternating systems are now manufactured by the General Electric Company for 25, 35, 50, 75, and 100 lamps The three larger sizes are arranged for multi-circuit connections, thus diminishing by one-half the potential strain on the circuit This potential on fully loaded systems with load equally divided on the two circuits is approximately as follows for 60 cycle circuits:

Lamps	Volts
25	2080
35	2920
50	2080
75	3100
100	4150

The above figures show the potential strain to which the insulation of the entire circuit is subjected under operating conditions Should an open circuit occur upon the line at any time, the open circuit voltage of the transformer is present at the break This voltage is as follows for 60 cycle circuits

Lamps	Volts
25	2300
35	3200
50	4600
75	6900
100	9200

With an open circuit and one of the lines grounded, as is liable to be the case when a line is broken and

down, the insulation from the ground to the line is subjected to the full open circuit voltage of the transformer.

Taking into consideration the fact that the insula-

FORM 3 A. C. SERIES ENCLOSED ARC LAMP.
With Reflector and Special Glass Insulating Hanger.—Fig. 1.

tion strain from the alternating current is 1.4 times that of the same potential direct current, it is self-evident that a line giving good results on an open arc direct current system may need considerable attention before it will be suitable for a series alternating system

The combination arc lamp hanger and individual cut-out, while not an essential part of the line construction, is extremely desirable in that it provides for changing the lamp upon a live circuit and affords protection to the employees.

The General Electric combination absolute cut-out and hanger is attractive in appearance and is strong enough to withstand any mechanical or electrical strain to which it will be subjected. Each cut-out is suspended by a petticoat insulator, thus preventing surface leakage in damp weather, and maintaining at all times, a perfectly safe insulation Many thousand of these cut-outs are in actual operation

Providing the flexible leads have not proper tips as now furnished with the hanger, Cat. No. 51855, the ends should be dipped in solder, so to furnish a solid foundation for the set screws and the end should be bent over, so that if the lead works loose from the set screws it cannot drop out and cause an open circuit. The joints of the line wire to the flexible cable should be properly twisted and soldered and then should need no further attention The leads at the cut-out terminal are securely fastened with set screws and the ends bent over so as to insure against an open circuit. Should it for any reason become necessary to remove the cut-out cover, care should be exercised to bring out the lead so as to correspond with the marking on the cut-out cover. If these matters are given a reasonable amount of attention, it will be found that this cut-out will prove entirely satisfactory and equal if not excel any cut-out on the market

In the manipulation of any system, the arc lamp trimmer should, at each trimming of a lamp, inspect the binding post connection This can be easily and

systematically done without any loss of time. The binding post set screws should be kept tightly set. Flexible cable connections to the binding posts should *positively* be used in all cases, otherwise loose binding posts and frequent open circuits must be expected.

ARC LAMP TESTING.

While arc lamps manufactured by the General Electric Company are carefully adjusted and inspected just before they are shipped, it is always advisable to test them under the exact conditions existing on the circuit, as it is frequently found that these conditions are not the same as those under which the lamps were tested and adjusted at the factory. It is always advisable to hang the lamps in the station and get them all adjusted before placing them on the street circuits. After the lamps have been tested and burn in the station for a short time, there is then no reason why everything should not go smoothly when they are installed on the street. It is very annoying and often expensive to install a number of lamps on the circuits and have something go wrong due to a trifling cause.

The only way to determine whether the lamps have been damaged in transportation is to test them before they are hung in the street; this involves but a comparatively slight amount of work and is a precaution well taken, no matter how perfect the lamp may be.

If the lamps do not operate according to the data given in the instruction book accompanying them, it will generally be found that the conditions of the circuit are not the same as those on which they have been tested; either the current is above or below normal or, with alternating apparatus, the frequency is above or below normal

ARC LAMP TESTING RACK IN GENERAL ELECTRIC COMPANY'S FACTORY

If the current is high the lamps will operate at higher arc voltage than normal; if low, the reverse will happen If the frequency is above that for which the lamps have been adjusted, the arc voltage will increase; if the frequency is low, the arc voltage will decrease To find the cause of the discrepancy, the speed should first be checked and made right, and second, the ammeter should be checked to learn if it is responsible for any apparent discrepancy It is sometimes impossible to change the speed or the frequency of the generator.

and in such cases the corrections can be made either by reducing or increasing current of the lamp circuit slightly or by readjustment of the lamps. Either method is comparatively simple and effective within reasonable limits.

A careful mechanical inspection should be made before lamps are placed on the street to insure that no screws have become loose or the lamps otherwise damaged in transportation. It is a comparatively simple matter to test and inspect the apparatus while in the station, as compared with the expense and delay in doing this work after they are scattered over a large territory.

CASING FOR STREET LIGHTING LAMPS.

For years the General Electric Company has recommended and used with great success the black enamel finished casing for street lighting, and experience has proved the wisdom of this recommendation.

Where lamps are to be installed near salt water, chemical factories, engine sheds, railroad yards or where otherwise they will be subjected to severe service, black oxidized copper casings are recommended. The cost is somewhat higher than that of black japan casings, but the durability under severe conditions fully warrants the increased installation expense.

CARE OF THE LAMPS.

By observing a few precautions in the trimming of enclosed lamps, a great deal of trouble will be prevented. The lamps are really more sensitive and require more careful handling than the old type of open lamps. At the same time, any trimmer of ordinary intelligence can be taught, in a very short time, to handle the lamps in a thoroughly satisfactory manner.

THE OUTER GLOBES.

After the lamp is lowered and the switch of the lamp or the cut-out is thrown (on series lamps) unscrew the clamping nut in the lower end of the globe a sufficient distance to allow the catch to be lifted, and the locking device released. The outer globe should then be lowered, care being taken to prevent the mouth of the globe from striking against the side frame, as in this way a small nick or crack may be started which will, in a short time, result in the complete breakage of the globe

The outer globe should now be dusted with a brush, raised carefully into position, the bayonet catch turned into place and the clamping nut screwed up until the outer globe is tight and properly secured.

It is a very poor practice to run lamps with outer globes cracked or broken, as it allows rain to beat into the globe, ruins the inner globe and cap and allows the outer globe to become filled with insects and dirt, thus obscuring a great portion of the light It also shortens the life of the carbons by admitting air more freely to the arc and cooling the inner globe. In very cold or wet weather, it may also result in the breaking of the inner globe

It will be found advisable to thoroughly wash outer globes occasionally, as even when globes are carefully wiped dry at each trimming, they will sooner or later become coated to such an extent as to cut off a considerable amount of light. How often globes will need washing depends entirely upon the care taken at each trimming and the condition of the atmosphere in which the lamps are operated.

ENCLOSING GLOBE CAP

Frequently enclosing globe caps are given no attention whatever. This is a serious mistake, especially if the lamps burn a great number of hours a night or are installed in a damp place. Repeated tests in our Experimental Department and also observations made at numerous central stations, show that the deposit upon the inner surface of the enclosing globe can be noticeably decreased by cleaning that portion of the globe cap

ENCLOSING GLOBE AFTER 2000 HOURS USE

surface which comes within the enclosing globe. At each trimming it will be found that this surface is covered with a light ashy deposit which can be easily brushed off.

Any dust or vapor mixed with gases carried from the arc will condense and deposit on the first cool surface, and this is naturally the cap. If the cap presents a

clean cooling surface it will condense a greater portion of the deposit. A deep coating deposited upon the cap acts as a heat insulator, so that further deposit finding no other cool surface is likely to condense on the side of the globe.

The lower surface of the cap should be brushed clean at each trimming to insure the least possible deposit upon the enclosing globe. If from any cause the under surface of the cap becomes much coated with rust, the cap should be taken to the station, if possible, placed in a lathe and the coating of rust scraped off until perfectly clean. The care of the cap is a very important item, as the deposit upon the inner globe and the life of the carbons depend directly upon the handling of this detail. The illustration on the preceding page shows a globe after a use of 2000 hours. Although slightly discolored at the top it is still serviceable.

ARC LAMP CARBONS.

The correct lengths of lower carbons, as given in the instruction book furnished with each lamp, should always be used. If too long a lower carbon be used, the arc comes too near the top of the globe and the enclosing cap. If too short a carbon is used, the arc will come too close to the bottom of the globe and the lower carbon holder. Either is destructive to the apparatus and will cause unnecessary and expensive renewals.

In the alternating current enclosed arc lamps, both multiple and series types, one cored carbon is used. With a certain current and voltage adjustment, the arc length will be considerably greater for a short period after the lamp is started with new carbon ends. This is

due to the lower resistance of the arc current path and carbon ends, while the soft dusty carbon particles and the carbon core are being consumed. The exact increased length of the arc above normal depends upon the condition of the individual carbons and the length of pick-up of the lamp mechanism.

Both the series and multiple types of General Electric alternating enclosed lamps are provided with limiting pick-up stop. Although the limiting pick-up stop, the length of lower carbon, and the dimensions of the enclosing globe are so proportioned as to cause a small globe breakage, it is a well-known fact that A LARGE PERCENTAGE OF GLOBE BREAKAGE OCCURS DURING THE FIRST FIFTEEN MINUTES OF BURNING AFTER RETRIMMING. Unfortunately at this time the lower carbon is of maximum length, so that the arc is near the cap and the top of the globe; at the same time the globe is undergoing a great temperature change which with a long flaming arc combines to produce the critical period in the life of the globe.

The carbon lengths have been so proportioned by designers of enclosed arc lamps that the stub remaining in the upper holder is of sufficient length for placing in the lower holder. Herein lies the opportunity of always having one previously burned carbon end for use in retrimming. Due to inequality of carbons, the upper carbon stub is often too long to be placed in the lower holder. In such a case the end which has been in the upper holder should be cut off and placed in the lower holder, leaving the burned end up.

This method of trimming both the series and multiple alternating enclosed arc lamps will noticeably lessen globe breakage.

All high grade carbons are so nearly uniform in dimensions, that little difficulty should be experienced from troubles such as were common in the earlier days of enclosed arc lighting. In order to obtain uniformity in carbon life, all carbons furnished by the General Electric Company are straight and free from blisters and have the following dimensions:

	Max.	Min.
½" Carbon	.520	.505
7/16" "	.445	.430
⅜" "	.400	.390

For these carbons the General Electric Company furnishes globe caps having the following standard openings:

	OPENING	
	Max.	Min.
½" Carbon	.494	.482
7/16" "	.458	.450
⅜" "	.407	.405

CARBON LIFE.

In the case of multiple enclosed lamps which are installed about a city in different stores, factories and other business places, uniformity of carbon life cannot be obtained. Individual lamps are not operated with any degree of regularity, and the trimmer must make frequent inspections, and often a sacrifice of full burning length of carbons must be made to lessen chances of trouble due to carbons burning out. On the series systems where a circuit of lamps is run as a whole it is

tully as IMPORTANT to get UNIFORMITY of CARBON LIFE throughout the entire number of lamps as to get long life It is fair to assume that the lamps are very similar in construction and that a reasonable amount of regularity should be secured Some of the CHIEF CAUSES of SHORT and erratic CARBON LIFE are as follows

LAMP ADJUSTMENT

Where an individual lamp shows short life at consecutive trimmings, and special care has been exercised in the trimming, it is very probable that the lamp is out of adjustment, and is operating at an excessive arc voltage This can be determined by an examination of the carbon ends When there has been a long flaming arc, the carbons are quite pointed and a white ashy deposit is apparent at a considerable distance from the end, depending upon the length of the arc. The lamp should be taken into the station and the adjustment checked with a voltmeter.

LOWER CARBON LENGTHS

Considering that 3" of lower carbon is available for consumption in our standard lamp using the No. 3 inner globe, it is evident that the number of hours life per inch or fraction of an inch is of considerable importance. A trimmer cutting his carbons at the lamp is very liable to be careless and not use the proper length. A difference of ¼" in length might not appear to be of

importance, but in the case of a pair of carbons giving 120 to 150 hours, ¼" of carbon would mean another night's burning. In the case of an alternating lamp giving a life of 80 hours, ¼" would represent about 5 hours burning, which would easily cause the difference between the satisfactory full life run and a lamp with carbons burned out, a trip of the inspector and a probable deduction by the city authorities.

Some definite arrangement should be made for cutting the carbons for the lower holders to the proper length. This can be readily done in the station by one man with such appliances as ingenuity may suggest.

In one large station an upright machine somewhat resembling a drill press has been designed. It has a knife which is operated by a small motor and tripped by a foot pedal. The carbon returned from the lamp where it has been used in the upper holder is pressed against a coil spring until it comes against a stop at a distance from the knife, equal to the required length of carbon. The mechanism is then tripped, and the knife, which has an edge of a half circle, is forced against the carbon and snaps it off. As soon as the carbon is cut, the spring throws the piece along a trough into the basket. Where a large number of lamps are to be trimmed each week, such a machine is a good investment, as it gives rapid and accurate results.

Another method is to have a tube or pipe closed at one end and having an inside length equal to the length of the carbon required. The carbon can then be placed in the pipe as far as it will go and cut off where it protrudes beyond the pipe end. A pair of pliers having a half round cutting edge will be found of considerable advantage.

Many other accurate and satisfactory methods of cutting the carbons can be devised.

UNIFORMITY OF QUALITY OF CARBONS.

Some occasional irregularity of carbon life is bound to occur from what might be termed "freak carbons," that is, very hard or soft carbon, and as the quality of the carbon is not apparent to the observer, these results must be accepted as unavoidable. The very hard carbon will give exceptionally long life, or when lamps are retrimmed at regular intervals, exceptionally long stubs will be found. The soft carbon will burn out before the time for retrimming. As a rule the standard high grade carbons are very uniform in quality and little trouble should be experienced from this cause.

CARBON DIAMETERS.

If the carbons and caps are within the diameter limits as given on page 18, no serious inequality of carbon life should occur. If carbons of smaller diameter are used, some sacrifice of life will be made.

If the globe is properly held in the lower holder, it will be air tight. It may be tested by placing the mouth over the top of the globe and blowing into it. This method would of course be found somewhat tiresome for a large number of globes, but some scheme could be devised whereby each globe could be tested by air pressure. This, however, should not be necessary where careful work can be secured.

INNER GLOBE BREAKAGE.

SATISFACTORY GLOBE LIFE.

In the earlier days of series enclosed lighting, 5 to 6 globes per lamp per year was the estimated breakage. Numerous stations now use only 2 or 3 globes per lamp per year, and in a few cases an average of less than one globe per lamp per year. So much difference exists in the degrees of perfection of the different arc lamp organizations that various and widely differing results are obtained.

In the more modern systems of arc lighting where the enclosed type of arc lamp is being used exclusively, the subject of enclosing globe renewals is an important item of central station maintenance. Upon the condition of the enclosing globe and the joints at the holder and cap, depend to a large extent the uniformity and length of the carbon life, which are some of the most important advantages claimed for enclosed arc systems. In order to secure these advantages, however, it is evident that there must not be too free an entrance of air to the enclosing globe, and this must be determined by frequent inspection, thus avoiding the continued use of defective globes.

CAUSES OF GLOBE BREAKAGE

A large percentage of unnecessary globe breakage can be traced to careless handling. No station manager or superintendent should countenance carelessness of employees resulting in the cracking or breaking of a large number of globes, but carelessness does exist, as shown by the number of globes having nicks at the top or bottom. These nicks, which are very easily overlooked, shorten the life of the carbon and form an excellent start for a crack when the globe is subjected to heat variation. No globe should be used which does not have perfectly ground edges.

In transportation and the operation of cleaning and placing the globe in its holder and beneath its cap, the same care should be exercised as in the handling of other equally fragile glassware. Each lamp trimmer should know that no lamp on his circuit has a cracked or nicked globe.

IMPROPER ADJUSTMENT OF LAMPS FOR EXISTING CURRENT CONDITIONS.

The destructive action of improper lamp adjustment with large watt consumption at the arc and excessive heat can be readily seen by an examination of the globes. They will be found to be sagged on one or all sides, due to softening of the glass, or the glass may be blackened at the top. A globe subjected to this intense heat will not maintain a true surface contact and should not again be used. Care should be taken to see that the lamp is properly adjusted for the circuit on which it is to run, and neither the lamp nor its adjustments should be condemned until the circuit conditions have been proved beyond doubt to agree with the actual conditions for which the lamp is adjusted.

REPAIRS.

The question of repairs should receive more attention on the part of the central station than is generally given. Very often nearly all repairs on the lamps are made by the line men or trimmers, and as long as the lamp gives light it is considered fit to hang on the customer's premises. This, however, is a serious mistake.

When any trouble occurs with the lamp, the cheapest and most effective method is to remove the lamp to the arc lamp repair room. The lamp should here be carefully cleaned, and the trouble, or cause of complaint, ascertained. In case any part has given out, it should be renewed or repaired in such a way that the lamp is as good as new. The lamp should then be examined for adjustment, and returned to the store-room properly marked, to indicate that it is again ready for installation. A small reserve of lamps should be kept on hand to cover lamps undergoing repairs, otherwise some lamps will surely be compelled to do service in a totally

PORTABLE INSTRUMENTS
FOR ARC LAMP TESTING

unsatisfactory condition, which is an expensive policy on the part of the central station, as the lamps in a very short time become ruined, and the rebates on account of the complaints from customers are often very high. It also reacts on the manufacturer of the lamp, who is thus often blamed for trouble for which he is not responsible.

All arc lamps should be inspected, and if necessary repaired, at least every year, every six months, or oftener, would be better if the lamp is operating continually, or in a bad location.

Every central station should have an arc lamp testing room with suitable facilities for hanging a number of lamps and connecting them to their proper circuits, also a suitable set of instruments which ordinarily will comprise a voltmeter and ammeter. It is particularly advantageous to have series lamps tested both on a recording voltmeter and a recording ammeter, as a lamp can then be run the entire night and an exact record kept of its operation. For more accurate tests, an indicating wattmeter is desirable to give wattage and power factor readings in connection with alternating lamps.

The testing rack can be conveniently arranged to suit local requirements.

The illustration on the preceding page shows a set of General Electric instruments recommended for arc lamp testing. This set consists of:

1 130 Volt Inclined Coil Portable Voltmeter.
1 15 Ampere Inclined Coil Portable Ammeter.
1 1500 Watt Inclined Coil Portable Wattmeter.

These instruments, while originally designed for alternating current work, are entirely satisfactory for use on direct current. When used on direct current reverse readings should be taken.

CLEANING ENCLOSING GLOBES.

If an enclosing globe be merely wiped or brushed out at occasional trimmings, the deposit burns into the glass, discoloring it and appreciably diminishing the amount of light. The globe must then be either destroyed or cleaned with acid. Repeated use of acid

GLOBE CLEANING ROOM.

shortens the life of the globe. Where the inner globes are returned to the station, the work can be done more thoroughly and by rapid methods.

In smaller stations, an ordinary pail of warm water, with or without soap, and an ordinary cotton mop will be found entirely satisfactory, as unless the globes have been discolored by excessive heat, the deposit washes

off by merely dipping the globe in the water, and one turn of the mop insures a clean globe.

In the larger stations, where a number of globes are to be washed each day, the work can be facilitated by a revolving brush.

GLOBE CLEANING ROOM.

An ordinary bristle brush, made to conform to the shape of the globe, is revolved at a speed of 1000 to 1200 revolutions per minute in a tank of water. An operator thrusts the globe over the brush once and the operation can be repeated at considerable speed. The brush can be operated by any available power and is continually under water when in use.

Another method in very successful use for the past two years by a large operating station is worthy of note.

A brush is made up of disks of cotton cloth clamped together upon a hollow shaft in layers about one-half inch thick. These layers are separated by washers slipped over the shaft so as to obtain flexibility of the disks for ease in inserting into the globe. The hollow shaft with disks clamped in position, ready for use, is six or eight inches long, and the disks are made smaller toward the lower end to conform roughly with the shape of the inside of the globe.

When running, a continuous stream of water is supplied through the hollow shaft and finds its way to the disks of cotton cloth through holes in the washers separating the several disks. The brush is revolved at 1100 revolutions per minute.

A similar brush made up of somewhat thicker disks is used to dry the globes after they have been washed.

TRIMMING.

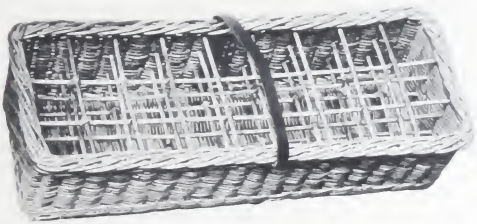
By the use of the station duplicate holder method of trimming, facilitated by the removable enclosing globe holder on General Electric lamps, the best results are obtained; first, as to the number of lamps taken care of by the trimmer; second, as to the condition of the inner globes, that is, mechanical perfection and freedom from deposit; third, breakage of inner globes per lamp per year; fourth, uniformity of carbon life.

For all series systems, the General Electric Company recommends trimming with a duplicate enclosing globe and holder and lower carbon prepared at the station. A duplicate set of lower holders equal to the number of lamps trimmed each day must be furnished, together with suitable means of transportation.

All of the latest open base globe types of lamps are fitted with the removable enclosing globe holder. This is removed from the lamp by releasing the two clamping nuts which hold it to the base, turning slightly to the left, and lifting it upwards and out.

The removing and inserting of the globe is the most delicate operation in the trimming of the lamp, and the one in which enclosing globes are most frequently damaged. Care should be taken to remove the globe without striking any of the metal parts, otherwise the edge of the globe will be nicked and its usefulness destroyed.

The lower holder, with dirty globe and carbon stubs, is returned to the station where a clean globe and a lower carbon of proper length are inserted. This lower holder trimmed complete is then ready to be carried out



BASKET FOR TRANSPORTING ENCLOSING GLOBES.

to trim another lamp. In some stations the trimmer or the day engineer does this work; in others a boy is detailed to spend all or a part of his time thus employed.

TRANSPORTATION.

In smaller stations a basket can be used to good advantage where the trimmer is obliged to walk over the circuit. Such baskets can be made like an egg crate,

with a compartment to hold each globe, so that the globes cannot rattle together and break. Where any number of lamps are to be taken care of, a horse and wagon, or trimming cart, can be used to great advantage A trimming cart designed and operated by the Toledo

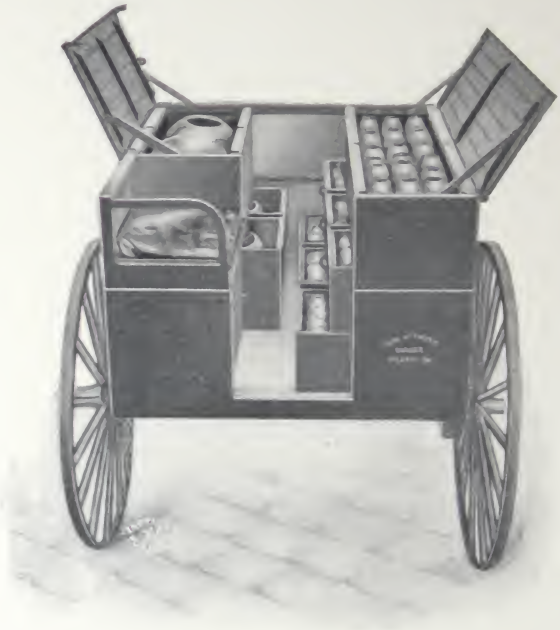
TRIMMING CART

Railways & Light Co amply protects the trimmer from unnecessary exposure and has suitable crates for carrying the inner globes, also two extra outer globes.

The number of lamps which can be taken care of by one trimmer will necessarily vary, and depends upon the

accessibility of the lamps, and the other work required of the same man, to say nothing of the individual man's ability. In many cases the trimmer is expected to patrol his circuit at night, and for that reason works short hours during the day; other trimmers do their own globe cleaning, carbon cutting, etc., in the station; others do their own inspecting of all reported troubles, changing of lamps, or even repairing and testing. Where lamps are reasonably accessible, a suitable horse and wagon are furnished and no other work is required, 80 to 125 lamps can be taken care of by each man.

Having the globes brought into the station at each trimming will give the superintendent an opportunity for securing information regarding the system, which would otherwise be very difficult for him to obtain. Here he has the globe and pair of carbons showing the condition of the lamp from which they have been taken. By examining the condition of these carbons and comparing their lengths a very good idea is obtained both of the individual arc adjustment, and the uniformity of arc adjustment of all lamps of the system. Flat and mushroomed ends together with exceptionally long residue carbons indicate low arc voltage and short arc; pointed carbons and short residue indicate flaming arc and immediately suggest an abnormal arc voltage, or possible undue entrance of air to the enclosing globe. An examination of the globe may disclose a crack, a nick at the top or bottom, a globe tilting or loose in the holder, or no asbestos washer. Individual cases of short arc and long life might occur from an exceptionally hard pair of carbons or from the core having dropped out of the upper carbon. Again, a pair of very soft carbons might be responsible for the long arc and short life, but



TRIMMING CART

generally speaking, a comparison of results during a certain period gives an opportunity for an efficient organization which is sure to produce commercially satisfactory and even gratifying results.

The illustration on the opposite page shows another very convenient style of trimming cart. This cart is especially designed to meet all requirements of the lamp-trimmer. It is conveniently arranged to carry 105 small globes and 4 large globes, has a convenient and roomy tool box under the seat, and the cases for the globes are well padded to prevent breakage. Only first-class materials and workmanship are used throughout. Carts of other capacities, and with a top, if desired, can be built to order. Price of carts is surprisingly low and will be quoted upon application.

RECORDS.

Some method of keeping records with suitable blanks to be filled out by the trimmer and inspector should be used in every case, no matter how small the system is. The exact system of record can vary greatly, and yet be entirely adequate.

On page 34 is a copy of one day's record in the month of March for a System of General Electric series alternating lamps; the following page shows a summary of the daily cards, giving a sum total of the actual results on the 313 series alternating lamps for the month of March, 1902; page 36 shows form used by night inspector.

A system of this kind can be accurately kept with little expense and the actual operating condition of the system quickly noted.

TRIMMER'S DAILY REPORT.—LIGHTING DEPT.

For March 7, 1902

Circuit Trimmed	No. Lamps	Inner Globes Broken	Outer Globes Broken	Lamp Parts Used
No. 3	*67*	*3*	*1*	*67 Cored Carbons*
TOTALS				

Remarks:

Lamp No. 137421 struck with trolley pole.

Both globes broken and lower frame bent.

Lamp changed.

NOTE. Report dangerous or faulty apparatus or line construction.

Trimmer, J. JOHNSON.

TRIMMER'S MONTHLY REPORT.—LIGHTING DEPT

For March, 1902.

TOTALS.

Circuit Trimmed	No. Lamps	Inner Globes Broken	Outer Globes Broken	Lamp Parts Used
	1648	*30*	*16*	
TOTALS				

Remarks:

313 Lamps.

Figured on above basis for 12 months.

138 Inner globes per lamp per year.

61 Outer globes per lamp per year.

NOTE. Report dangerous or faulty apparatus or line construction.

Trimmer, J. GRIFFEN.

NIGHT INSPECTOR'S REPORT.—LIGHTING DEPT.

For March 7, 1902.

TIME	LAMPS STARTED	CAUSE OF TROUBLE	CHANGE
	None		
	LAMPS OUT		
3 A. M.	*1*	*Struck by trolley pole*	
	LAMPS BURNING BELOW C P.		
	None		

NOTE. Report dangerous or faulty apparatus or line construction.

Night Inspector, S. HEARN.

MAY 6, 1902.

The following extract is from the Annual Report of a prominent Lighting Co. of Mass

"We have in service 164 arc lamps and a number of incandescent street lights. From March 18th, 1901, to March 18th, 1902, the lights burned 3047 hours, were trimmed 36 times, using 5638 carbons, 239 inner globes, 36 outer globes."

This company is using a General Electric series alternating system. From this it will be noted that the life of the carbons for each trimming is about 84½ hours. The number of inner globes used per lamp per year is 1.45; the life of each globe over 2000 hours.

While these records show accurate results obtained, it must not be expected that every station can show equally good results until they have had some experience with the system.

H. M. ATKINSON, Pres. G. W. BRINE, Sec. & Treas. J. G. ROSSMAN, Gen. Supt.

Georgia Electric Light Company

GENERAL OFFICES & SUB STATION
GEORGIA ELECTRIC LIGHT BUILDING,
24 EAST ALABAMA ST.

PHONES 1474

Atlanta, Ga., August 6, 1902

JOHN M. SMITH CARRIAGE COMPANY.
ATLANTA, GA.

GENTLEMEN:

Several months ago we placed an order with you for two trimmer's carts, which carts were of special design, and have been used by our city arc lamp trimmers. These carts were designed to carry the inner globes, outer globes, and any other material which was necessary for the trimming and care of the street lamps. Previous to the installation of the series enclosed arc lamp system, we employed nine city trimmers. At the present time we employ two trimmers and each is provided with a cart. We believe this type of cart is especially adapted to the work. You were very careful in carrying out the details of the design. The workmanship is excellent, and we do not anticipate any trouble in the future.

Very truly yours,

J. G. ROSSMAN,
General Superintendent.

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